Processing or Conversion

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Processing or conversion represents an important intermediate series of steps in the bioenergy value chain bridging the gap from renewable feedstocks to end products. Potential starch, cellulose, lignin or oil-based feedstocks may be derived from plant, marine or animal-based sources. While processing technologies are relatively mature in the case of corn and sugar cane-based ethanol production, new processing technologies, including new biochemical-based fermentations and bioconversions, pre-treatments and enzymatic hydrolysis, fractionation, product separation and bioconversion, gasification-fermentation, and thermo-chemical conversions offer significant opportunities for improving the carbon and energy life cycle as well as the economic viability and sustainability of a particular process. For example, retrofit of existing corn ethanol facilities in the US Midwest to include new processing unit operations that would allow for the additional utilization of fiber-containing co-products such as distillers grains and the production of end products (e.g. higher alcohols, organic chemicals, ketones, polymers, etc.) other than ethanol can help to diversify and vertically integrate the biorefinery of the future.

It was recently estimated that the global renewable chemicals market will be worth $59B by 2014 (www.marketsandmarkets.com). The types of platform chemicals that could be produced in the biorefinery of the future include: diacids, carboxylic acids, aspartic acid, gucaric acid, glutamic acid, itaconic acid levulinic acid as well as higher alcohols such as butanol. Platform chemicals play an important role in the renewable chemicals market since their multiple functional groups can be converted to families of highly useful and valuable chemicals.

What are the prospects for converting lipid, sugar, starch and cellulosic feedstocks into aviation fuel?

To allow for the successful conversion of renewables such as lipids, sugars, starch and cellulosic feedstocks into aviation fuel will require the correct mix of disciplinary expertise (e.g. chemistry, fermentation microbiology, polymer and fuel science). A number of new technologies are on the horizon for the production of liquid hydrocarbons directly from biomass. These hydrocarbons will be produced using strategies based either on microbial fermentation, catalytic approaches, pyrolysis or gasification. The resulting hydrocarbon-based biofuels can be direct replacements for gasoline, diesel and jet fuel. There are universities and companies working in these areas that are focused on making these processes economically viable.

Is there a relationship of these conversion methods and feedstock supplies to food/fuel issues?

Currently, there is more of a concern with the conversion of starch or oil seeds (which are seen as foodstuffs) than there is with cellulosic feedstocks. However, if done correctly, using appropriate models for life cycle analysis, most feedstocks can be used for both food and fuel. An interesting aspect for the direct production of hydrocarbons from biomass is the higher energy density of the resultant material and compatibility with existing infrastructure. Taken together, these factors would likely have a positive impact on the life cycle and help to reduce concerns over food vs. fuel issues.

How can the Air Force contribute to developments in technology, organization and policy that would accelerate the aviation biofuels industry?

Providing a vision for the use of renewable aviation fuels in the 21st Century fleet of aircraft would be a good start. That should then be followed by an examination of the expertise available at various Universities and companies and development of a working strategy for accomplishing the desired goals.